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(71) Applicant: TELEFONAKTIEBOLAGET LM ERICSSON (publ) [SE/SE]; S–126 25 Stockholm (SE).

(72) Inventor: STILLE, Ola, Mats; Åsögatan 116, S–116 24 Stockholm (SE).

(74) Agent: ERICSSON RADIO SYSTEMS AB; Common Patent Dept., S–164 80 Stockholm (SE).

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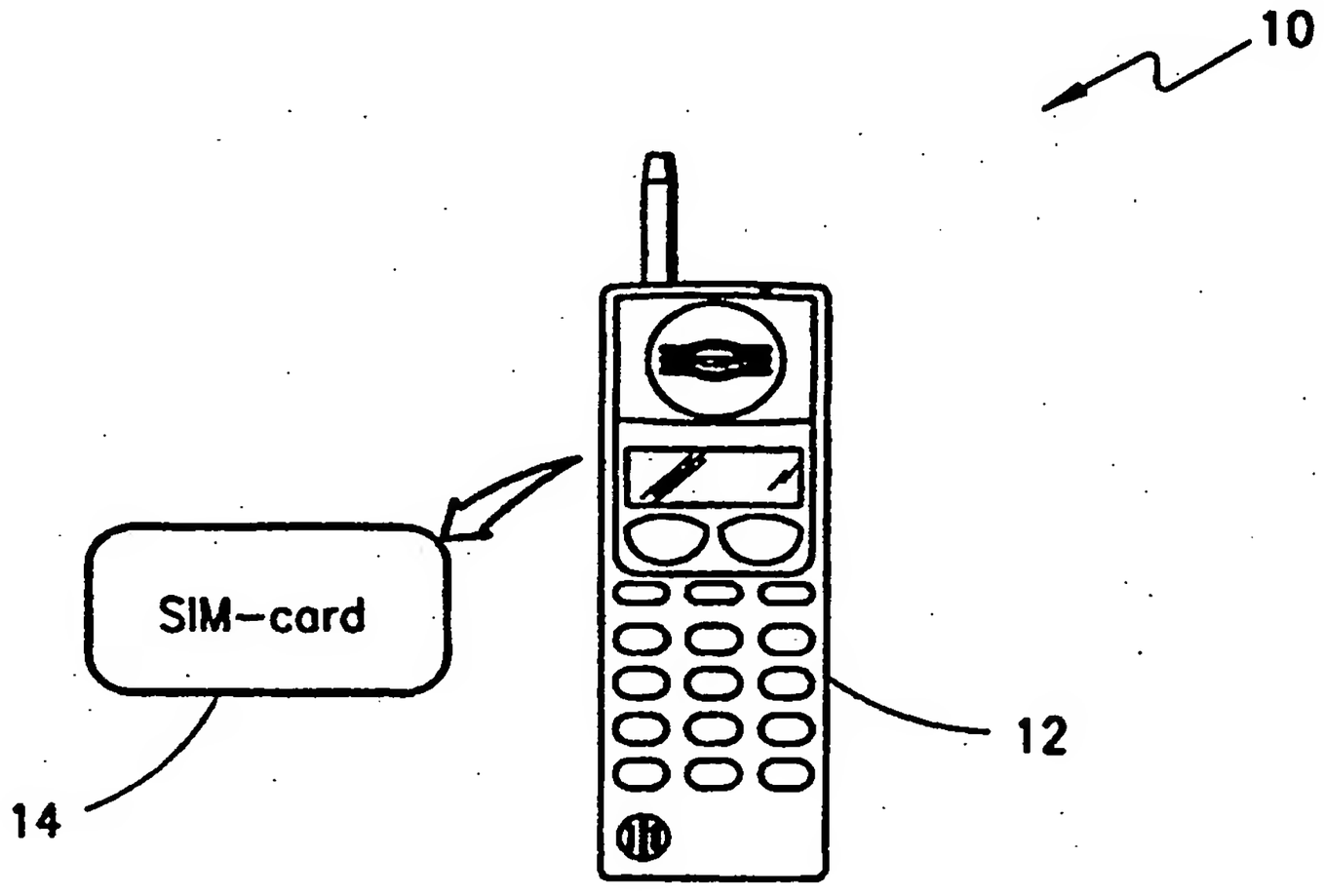
(54) Title: INTELLIGENT PRE–PAID SERVICE CARD FOR A MOBILE PHONE

(57) Abstract

An Intelligent Pre–paid Service Card (IPSC) (114) for a mobile phone (10) is disclosed, whereby the IPSC (114) performs call charge calculations, instead of the mobile network. The IPSC (114) can be integrated with a conventional SIM card in the mobile phone (10). As such, the mobile network does not have to transmit call charging information to the mobile phone (10). Consequently, any network can handle calls for a roaming pre–paid subscriber whose mobile phone (10) includes an IPSC (114).



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INTELLIGENT PRE-PAID SERVICE CARD FOR A MOBILE PHONE

BACKGROUND OF THE INVENTION

Technical Field of the Invention

The present invention relates in general to the telephony accounting field and, in particular, to a method and apparatus for ensuring that roaming pre-paid subscribers can make, and be charged for, mobile telephone calls.

Description of Related Art

Most mobile telephone subscribers pay for their mobile calls after they receive a monthly bill from their service provider (commonly referred to as "post-paid" accounting). However, this process of monthly accounting requires a substantial amount of administrative support in order for the service provider to collect the call data, calculate the costs for the calls, send bills to the subscribers, etc.

In order to reduce the monthly accounting administrative burden, some mobile telephone system operators have been offering pre-paid (accounting) services to their subscribers. Generally, there are three mobile pre-paid accounting approaches in use: (1) the Intelligent Network (IN) approach; (2) the Call Detail Record (CDR) network approach; and (3) the Advice of Charge (AoC) network approach. Using the IN pre-paid accounting approach, a subscription for each pre-paid customer is stored in a subscriber database in a system's IN node. Each subscription field in the IN node contains certain information such as, for example, the number of charging units (to be used for the payment of a call), dates (e.g., when the charging units or subscription will expire, when announcements are to be played, etc.), and other subscriber-related information (e.g., tariff class, lists of barred and allowed numbers, and other restrictions and information about subscribers). This subscriber information can be stored in the IN's Service Control Function, an external database (e.g., a Service Data Function), or both. The charging units can be any unit value, as long as the unit is fully convertible between monetary value, time value, etc.

For mobile telephone systems using the CDR network approach for pre-paid accounting purposes, the call data records are collected similar to those in conventional billing systems. However, a difference between the post-paid CDR and pre-paid CDR network approaches is that the pre-paid CDR network approach maintains a dedicated pre-paid account in a database for each mobile subscriber. When a call has been made and a resulting CDR is being processed by the system, the cost of the call is calculated and deducted from the amount in the subscriber's account. If the account reaches zero, the pre-paid system orders the mobile network to bar the subscriber from making additional calls. Some of the network operators allow the pre-paid amount to reach zero without restricting the call, but those operators eventually charge the subscriber by post-processing the CDRs in a post-paid billing system.

For mobile telephone systems using the AoC network approach for pre-paid accounting purposes, AoC information for a pre-paid subscriber is sent from the network and received by the subscriber's mobile phone. The mobile phone forwards the received AoC information to its Subscriber Identity Module (SIM) card, where special pre-paid application software resides. The pre-paid software routine deducts the AoC amounts from a pre-paid amount stored in the SIM card. Again, this is a network-based pre-paid accounting approach.

A significant problem with existing mobile telephone systems that offer pre-paid services is that roaming and outgoing calls are restricted. The main reason for these restrictions is that the home area mobile telephone network operator/service provider cannot rely on the principle that all visited networks of other countries where the end-user may roam, are technically supporting the CDR, IN or AoC approaches in accordance with the requirements of the home area mobile telephone network operator/service provider. The home area mobile telephone network operator/service provider simply cannot assume the risk of the end-user being able to make calls free of charge due to a visited network's incompatibility with any of the three pre-paid network approaches.

As an example, for the AoC approach, the mobile telephone networks need to transfer call charge information to the pre-paid accounting application software that resides in the SIM cards located in the mobile phones. The pre-paid

application software deducts the call charges from the pre-paid charging units stored in the SIM card. The main problem with such an AoC arrangement is first, that very few visited networks support AoC at all, which makes these networks invalid for roaming. Second, even if the visited network were to support AoC, the home network operator would have no influence on the call charge transferred to the mobile phone, because it would be the visited network that would set and transfer the call charge information to the mobile phone. Consequently, if the pre-paid subscriber leaves the mobile phone's home network area (e.g., for a vacation), the home network operator would have to transfer a call barring order on the pre-paid subscriber to the visited network, since the AoC would not be guaranteed to be handled at all, or at least in the way that the home operator would want the call charges to be handled. However, as described in detail below, the present invention successfully resolves these problems.

SUMMARY OF THE INVENTION

An Intelligent Pre-paid Service Card (IPSC) is provided for a mobile phone, whereby the IPSC performs call charge calculations, instead of the network. In a preferred embodiment of the invention, an IPSC is integrated with a conventional SIM card in a mobile phone. As such, the mobile network does not have to transmit call charging information to the mobile phone. Consequently, any network can handle calls for a roaming pre-paid subscriber whose mobile phone includes the present IPSC.

An important technical advantage of the present invention is that roaming pre-paid subscribers' calls are not restricted, and calls can be placed or received at any location.

Another important technical advantage of the present invention is that mobile phone pre-paid services can be provided without the need for backup post-processing.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of the method and apparatus of the present invention may be had by reference to the following detailed description when taken

in conjunction with the accompanying drawings wherein:

FIGURE 1 is a simplified block diagram of an exemplary mobile radiotelephone, which can be used to implement the preferred embodiment of the present invention; and

FIGURE 2 is a simplified block diagram that illustrates an exemplary SIM card with an Intelligent Prepaid Service Area that can be used to implement a preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE DRAWINGS

The preferred embodiment of the present invention and its advantages are best understood by referring to FIGUREs 1-2 of the drawings, like numerals being used for like and corresponding parts of the various drawings.

Essentially, in accordance with the present invention, an IPSC is provided for a mobile phone, in which the IPSC performs call charge calculations, instead of the network. In a preferred embodiment of the invention, an IPSC is integrated with a SIM card in a mobile phone. As such, the mobile network does not have to transmit call charging information to the mobile phone. Consequently, any network can handle calls for a roaming pre-paid subscriber whose mobile phone includes the present IPSC.

Specifically, FIGURE 1 is a simplified block diagram of an exemplary mobile radiotelephone 10, which can be used to implement the preferred embodiment of the present invention. For example, mobile radiotelephone (phone) 10 can be a mobile terminal or mobile station operating in a cellular communications system, such as, for example, the Global System for Mobile Communications (GSM), the Personal Digital Cellular (PDC) system, or the Advanced or Digital-Advanced Mobile Phone System (AMPS or D-AMPS). As such, the present invention can be implemented in any mobile phone that utilizes a SIM or similar feature. As shown, the exemplary mobile phone 10 includes a SIM 14, which can be, for example, configured as an ID-1 SIM (format and layout in accordance with the ISO standards for integrated circuit cards), or a plug-in SIM (e.g., semi-permanently installed).

FIGURE 2 is a simplified block diagram that illustrates an exemplary SIM card 114 that can be used to implement a preferred embodiment of the present invention. For this exemplary embodiment, SIM card 114 includes an Intelligent Prepaid Service

Area (IPSA) 116 integrated with the SIM card 114. The IPSA 116 includes a memory storage area (not shown), which can be addressed (read from and written to) by a processor located in the mobile phone 10. The IPSA memory includes the IPSA software routine(s) used for performing calculations and processing of the pre-paid service call charge information. The IPSA software routine(s) are preferably executed by the processor located in the mobile phone.

Preferably, an initial charge limit value (e.g., $100.00), which the subscriber/user of the mobile phone 10 has paid for, is stored as units in the IPSA 116 of the SIM card. For example, a subscriber can purchase new call limit units at any appropriate retail store, or directly from a mobile network operator or service provider at a designated location. The network operator and service provider can sell IPSCs with their respective brand names on the cards. Essentially, a user can change network operators by simply purchasing a specific operator's plug-in IPSC. The IPSC (via the IPSC/SIM interface) will cause the mobile phone to select the appropriate network to connect with according to the network issuer of the IPSC. If the mobile phone is "roaming" in a country other than the "home" country, the mobile phone will be able to select a cooperating network to connect with in the visited country, based on information provided by the SIM card and user choice. Alternatively, a network operator can input the initial, or refill, charge limit value directly to the mobile phone (e.g., password-authorized keypad entry), or the initial charge value can be downloaded at an appropriate time from the network via the radio air interface (e.g., only while the phone is located in its home network area).

For accounting purposes (if necessary), the home network's mobile services switching centers (MSCs) can create CDRs for the IPSC mobile phone calls in the same way as that used for non-IPSC mobile phone calls. However, the home network operator's administrative systems (billing centers) would not use those CDRs for payment settlements with the IPSC subscribers, but preferably would use them only for accounting purposes with the visited countries' cooperating network operators.

When the user of mobile phone 10 makes a call, the IPSA software extracts the dialed party's number from the terminal part of the mobile phone via the SIM card-terminal interface. The IPSA 116 memory area includes a charging analysis table, which is used to determine a call charge rate based on the dialed party's number. For

simplicity sake, the preferred embodiment is described herein as utilizing a flat-rate oriented charge scheme. For example, the IPSA software can apply only one tariff for all national number calls dialed. The IPSA software can apply one national tariff as per visited country (e.g., 0.5 GBP/60 seconds in visited UK GSM networks, 1.0 DEM/60 seconds in visited German GSM networks, and 1.0 USD/60 seconds in the United States.

For international calls, a flat rate can be used on a per country or continent basis (as seen from the home network's perspective). In other words, for the continent case, one tariff can be applied for calls made to Europe, a second tariff for calls to North America, a third tariff for calls to South America, a fourth tariff for Asia, a fifth for Australia, and a sixth for Africa (seven tariffs including the home nation).

Once the IPSA 116 software determines the charge for a call (from the charge analysis table), the software waits for an indication (via the SIM card-terminal interface) that the dialed call has been connected. When the end-user makes a an international call by pressing, for example, the "+" key (substitute for the international carrier prefix) followed by the country code, the IPSA 116 software extracts the country code digits, compares them with the charges listed for that country in the charge analysis table, and sets the appropriate tariff for that destination country or continent. Alternatively, if the end-user dials an international carrier prefix instead of pressing the "+" key, the IPSA 116 software analyzes the dialed number and determines from the first few digits that the dialed number has an international format according to the country of the visited network. The IPSA 116 software then extracts the country code digits, compares them with the charges listed for that country in the charge analysis table, and sets the appropriate international tariff for that destination country or continent.

As such, the IPSA 116 software waits for receipt of a remote end answer signal (e.g., a Q931-based CONNECT message in the PDC and GSM). If the remote end answer signal is not received (e.g., after a time-out duration of 30 seconds), the IPSA software does not institute the charging subroutine(s).

If the IPSA software receives a remote end answer signal (the dialed call has been connected), the charging subroutine is initiated to start a unit countdown. For example, the countdown can be made as 30 seconds per unit for national calls, and 15

seconds per unit for international European calls. If the initial charge amount paid by the mobile phone subscriber is $100.00, this amount would correspond to 100 units stored in the IPSA (e.g., at $1.00 per unit). This would result in a $1.00 per 30 second conversation time for national U.S. calls, and $2.00 for a similar duration international European call.

After the call (and unit countdown) is completed, the IPSA 116 software stores the remaining amount of units for the next call. If the number of remaining charging units falls below zero during a call, the IPSA software issues a "call terminate" order message via the SIM card to the terminal part of the mobile phone, which functions to drop the call. However, as an option for this embodiment, the IPSA software can issue a notification message to the terminal part of the phone when, for example, a certain amount of (e.g., 10) charging units remain. In response, the terminal can generate a "low charging unit" tone from the phone's speaker for the end-user to hear. When there are no units remaining in the IPSA memory store, the IPSA software preferably prohibits any additional calls until the operator/service provider/user inserts a new IPSA card (or the operator/service provider keys-in a new amount) with more than a threshold amount of charge units.

Although a preferred embodiment of the method and apparatus of the present invention has been illustrated in the accompanying Drawings and described in the foregoing Detailed Description, it will be understood that the invention is not limited to the embodiment disclosed, but is capable of numerous rearrangements, modifications and substitutions without departing from the spirit of the invention as set forth and defined by the following claims.

WHAT IS CLAIMED IS:

1. A method for providing a prepaid call service from a mobile phone, comprising the steps of:

said mobile phone storing an initial value associated with said prepaid call service;

said mobile phone determining a charge value for a call made with said mobile phone; and

said mobile phone subtracting said charge value from said initial value.

2. The method of Claim 1, wherein said initial value is stored in an intelligent prepaid service area memory store in said mobile phone.

3. The method of Claim 1, wherein the determining step comprises counting down for a duration of said call.

4. The method of Claim 1, wherein said charge value is associated with a predetermined charge rate for said call.

5. A mobile phone for use in providing a prepaid call service, comprising:

a subscriber identity module;

a prepaid service module connected to said subscriber identity module; and

a processor coupled to at least one of said subscriber identity module and said prepaid service module, said processor operable to:

store an initial value associated with said prepaid call service in said prepaid service module;

determine a charge value for a call made with said mobile phone; and

subtract said charge value from said initial value.

6. The mobile phone of Claim 5, wherein said processor is operable to perform a countdown for a duration of said call.

7. The mobile phone of Claim 5, wherein said charge value is associated

with a predetermined charge rate for said call.

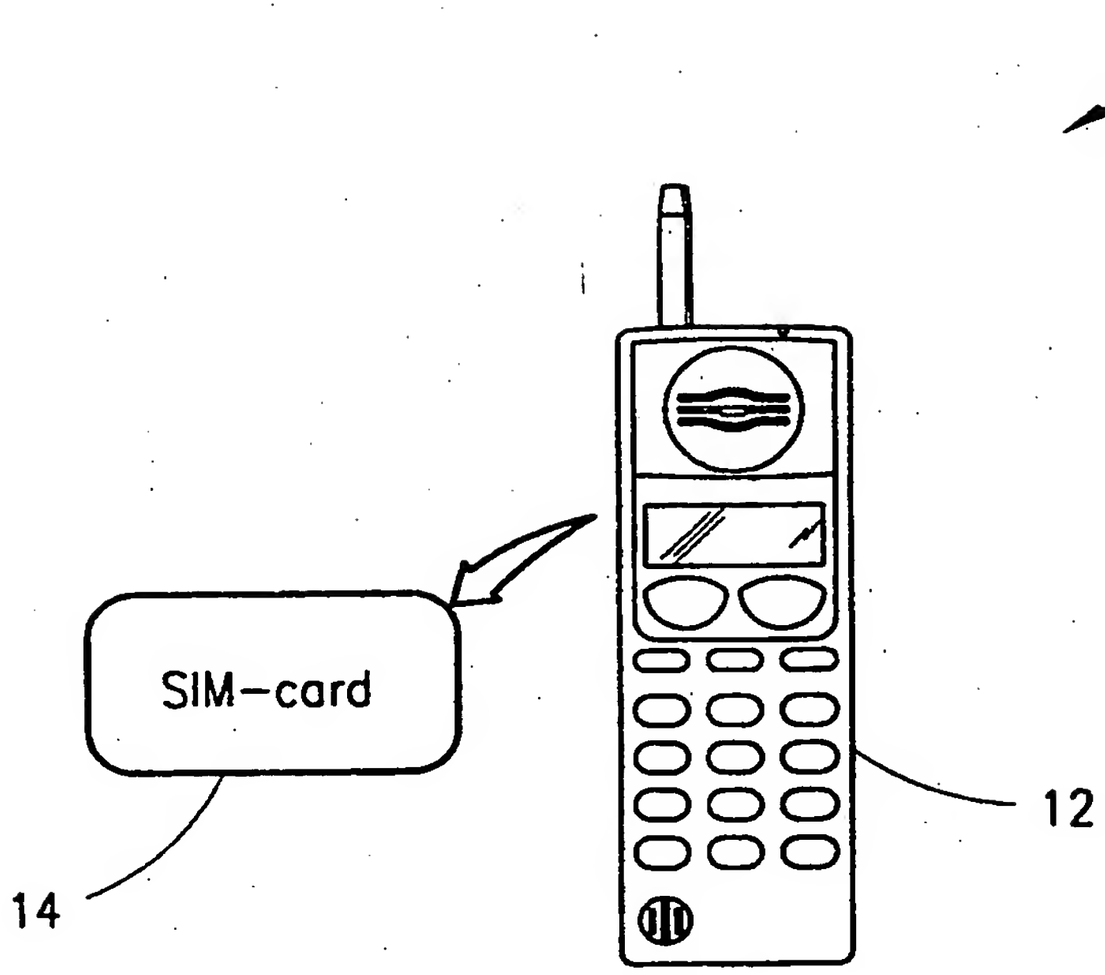

FIG. 1

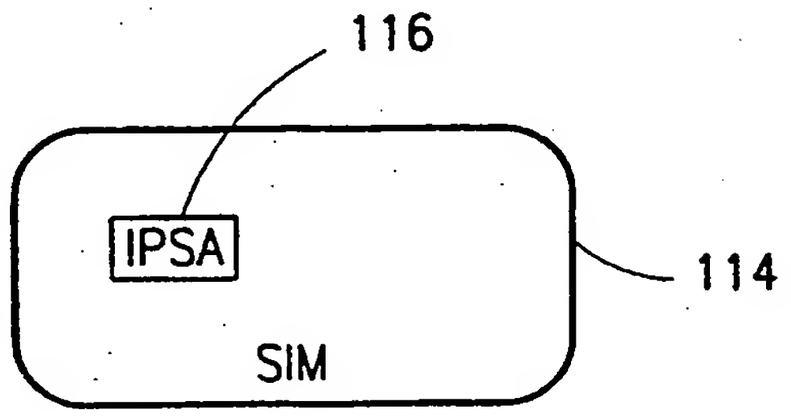

FIG. 2

INTERNATIONAL SEARCH REPORT

International Application No
PCT/SE 99/00368

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04M15/30 H04M17/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04M H04Q

Documentation searched other than minimum documentation tc the extent that such documents are included in the fields searched

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 95 28062 A (NOKIA TELECOMMUNICATIONS OY) 19 October 1995 see claim 2 see page 6, line 21 - page 7, line 2 see page 9, line 24 - page 10, line 3 ---	1-7
X	EP 0 790 587 A (PHILIPS ELECTRONICS NV) 20 August 1997 see column 3, line 26 - column 4, line 21 see claims 1,3,4 ---	1-7
X	GB 2 308 528 A (KARAGOEZLUE IBRAHIM MURAT ;RAMIS HARRY (GB)) 25 June 1997 see page 4, line 1 - page 5, line 27 see claims 1,2,4 --- -/--	1-3,5,6

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Name and mailing address of the ISA	Authorized officer
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 577 100 A (MCGREGOR DONALD S ET AL) 19 November 1996	1-4
A	see column 1, line 45 - column 3, line 15 see claims 1,6	5-7
X	US 5 631 947 A (CIOCCA GIACOMO A ET AL) 20 May 1997	1-4
A	see column 3, line 52 - line 63 see claims 8,12	5-7
A	FR 2 727 270 A (VARY DIDIER) 24 May 1996 see abstract	1-7
A	GB 2 267 794 A (CONROY ALAN KILPATRICK) 15 December 1993 see abstract	1-7

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/SE 99/00368

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9528062 A	19-10-1995	AU 691604 B	21-05-1998
		AU 2216795 A	30-10-1995
		CN 1151240 A	04-06-1997
		EP 0754394 A	22-01-1997
		FI 963996 A	05-12-1996
		JP 10501931 T	17-02-1998
		US 5748720 A	05-05-1998
EP 0790587 A	20-08-1997	FR 2744822 A	14-08-1997
		CN 1168609 A	24-12-1997
		JP 9233541 A	05-09-1997
GB 2308528 A	25-06-1997	NONE	
US 5577100 A	19-11-1996	AU 695509 B	13-08-1998
		AU 4901096 A	21-08-1996
		BR 9606875 A	23-12-1997
		CA 2211892 A	08-08-1996
		CN 1176039 A	11-03-1998
		EP 0808547 A	26-11-1997
		JP 10513618 T	22-12-1998
		WO 9624229 A	08-08-1996
US 5631947 A	20-05-1997	AU 1550992 A	06-10-1992
		CA 2105570 A	05-09-1992
		EP 0576552 A	05-01-1994
		WO 9216078 A	17-09-1992
FR 2727270 A	24-05-1996	AU 4263896 A	17-06-1996
		WO 9616504 A	30-05-1996
GB 2267794 A	15-12-1993	NONE	